Claims

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. An instrumentation system for variable depth tillage comprising:
at least one soil engaging implement;
at least two load cells mounted to the soil engaging implement; and,
at least one set of strain gauges mounted to the soil engaging implement.

2. The instrumentation system for variable depth tillage as described in claim 1 wherein the soil engaging implement has an upper end mounted to a support structure, a lower end, a point for engaging the soil mounted to the lower end, a leading edge, and a protective shin mounted to the leading edge.

3. The instrumentation system for variable depth tillage as described in claim 2 wherein the at least two load cells are interposed between the protective shin and the leading edge of the soil engaging implement.

4. The instrumentation system for variable depth tillage as described in claim 1 wherein each set of strain gauges is a bridge type configuration.

5. The instrumentation system for variable depth tillage as described in claim 2 wherein two sets of strain gauges are mounted to the soil engaging implement at different depths.

6. The instrumentation system for variable depth tillage as described in claim 1 wherein the load cells are used to determine a linear trend of topsoil resistance pressure change with depth as the soil engaging implement is drawn through the soil.

7. The instrumentation system for variable depth tillage as described in claim 6 wherein the at least one set of strain gauges is used to measure torque on the soil engaging implement caused by the load transmitted through the at least two load cells as well as the load applied to the point of the soil engaging implement.

8. The instrumentation system for variable depth tillage as described in claim 7 wherein the linear trend of topsoil resistance pressure change with depth and the torque on the soil engaging implement are used to determine measured (p_p) and predicted (p_{sh}) mechanical soil resistance to penetration applied to the point and the difference between the two values is an input for tillage depth adjustment.

9. The instrumentation system for variable depth tillage according to claim 8 wherein a linear distribution of soil resistance pressure p_{sh}=f(y) is calculated from a free body diagram based on load cell and depth measurements where y is the vertical coordinate with respect to the tip of the point (14).

10. The instrumentation system for variable depth tillage according to claim 9 wherein a free body diagram of the standard and point assembly is used to derive $p_p = f(y)$ based on both load cell and strain gauge measurements and the difference between p_p and p_{sh} serves as a key input to guide the tillage implement to an appropriate operation depth.

11. A method for determining tillage depth for a soil engaging implement comprising the steps of:

providing at least one soil engaging implement having an upper end mounted to a support structure, a lower end, a point for engaging the soil mounted to the lower end, a leading edge, and a protective shin mounted to the leading edge;

interposing at least two load cells between the protective shin and the leading edge of the soil engaging implement;

mounting at least one set of strain gauges on the soil engaging implement;

determining a linear trend of topsoil resistance pressure change with depth from the load cells as the soil engaging implement is drawn through the soil;

determining from the strain gauges a measured torque on the soil engaging implement caused by the load transmitted through the at least two load cells as well as the load applied to the point of the soil engaging implement;

determining measured (p_p) and predicted (p_{sh}) mechanical soil resistance to penetration applied to the point from the linear trend of topsoil resistance pressure change with depth and the torque on the soil engaging implement;

using the difference between measured and predicted mechanical soil resistance to penetration applied to the point as an input for adjusting the depth of the soil engaging implement.